TEMPERATURE CONTROL LOUVERS FOR THE MARINER VENUS AND MARINER MARS SPACECRAFTS

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The function of active temperature control devices is to suppress temperature excursions and provide tighter temperature regulation than would otherwise result. Were it not for the widely varied heat inputs to spacecraft subassemblies, and for the bearing which temperatures have upon reliability and endurance, active temperature control devices would not be required.

Louvers are but one type of active temperature control device. Figures I and II show the louver systems designed for Mariner R and C respectively. Whereas they differ somewhat in configuration, mechanically and functionally they are similar. Mechanical features common to both systems are listed in Table I. An overall comparison is provided in Table II.

Thermal performance for the two systems in terms of the effective emittance as a function of louver blade angle is given in Table III. Theoretical performance values are also given for comparison (ref. JPL TR 32-555, Analysis of Movable Louvers for Temperature Control, J. Plamondon, 1964). The theoretical values have been based on diffuse emission-reflection, infinite length louver blades, and assumes no heat loss from bracketry.

In order to rationalize empirical and theoretical performance figures, an adjustment has been made to the empirical values, forcing them in agreement with theoretical values for the fully closed louver condition. The adjustment (or tare) may be considered to be an area of unit emittance which radiated in parallel with the louvers. The adjusted thermal performance figures are given in Table IV, and as can be seen are in only fair agreement with the theoretical values. The differences are felt to stem primarily from experimental errors made during the measurement of louver performance, and to a lesser extent from the inexact nature of the mathematical model.

TABLE I

Mechanical Features of the Mariner Louver System

1. Louvers are individually actuated--not ganged.

2. Louver sensing and actuating elements are spiral-shaped bimetal coils.

3. The bimetal sensor-actuator is primarily radiatively coupled with the "sensed" temperature.

4. Louver blades are made of thin gauge polished aluminum alloy sheets.

5. Louver blades are center pivoted (1) to better withstand dynamic environments, and (2) to permit their usage in any spacecraft attitude during test.

6. Louvers are supported in bushing type bearings.

7. The temperature for incipient opening of the louvers may be varied by adjusting the anchor point of the bimetal coil.

8. Individual louvers may be removed from the assembly easily for replacement, cleaning, or inspection without affecting the louver adjustment.

TABLE II

Comparison of Mariner II and Mariner C
Louver Assemblies

		MA-II	MA-C
1.	Effective emittance closed	.08	.12
2.	Effective emittance open	.72	.76
3.	Area of louver assembly	1.76 lb/sq. ft.	1.62 sq. ft.
4.	Weight	2.20 lb.	1.35 lb.
5.	Weight per area ratio	1.76 lb/sq. ft.	.83 lb/sq. ft.
6.	Actuation range	$30^{o}F$	$27^{o}F$
7.	Year designed	1961	1963
8.	Year flown	1962	1964 (?)
9.	Static bearing friction in one-G field	9^{o} angle	6^{o} angle
10.	Louver thickness	20 mil	2 layers 5 mil
11.	Attachment to chassis	rivet	bolt

TABLE III

(LOUVER PERFORMANCE)

Louver Angle	Effective Emittance		
	Mariner II	Mariner C	Theoretical
0°	.08	.12	.03
30	.37	.57	.37
60	.61	.71	.57
90	.72	.76	.63

TABLE IV

(ADJUSTED LOUVER PERFORMANCE)

Louver Angle	Effective Emittance		
	Mariner II	Mariner C	Theoretical
0°	.03	.03	.03
30	.32	.48	.37
60	.56	.62	.57
90	.67	.67	.63
Tare	9.0 Sq. In.	21.0	* --

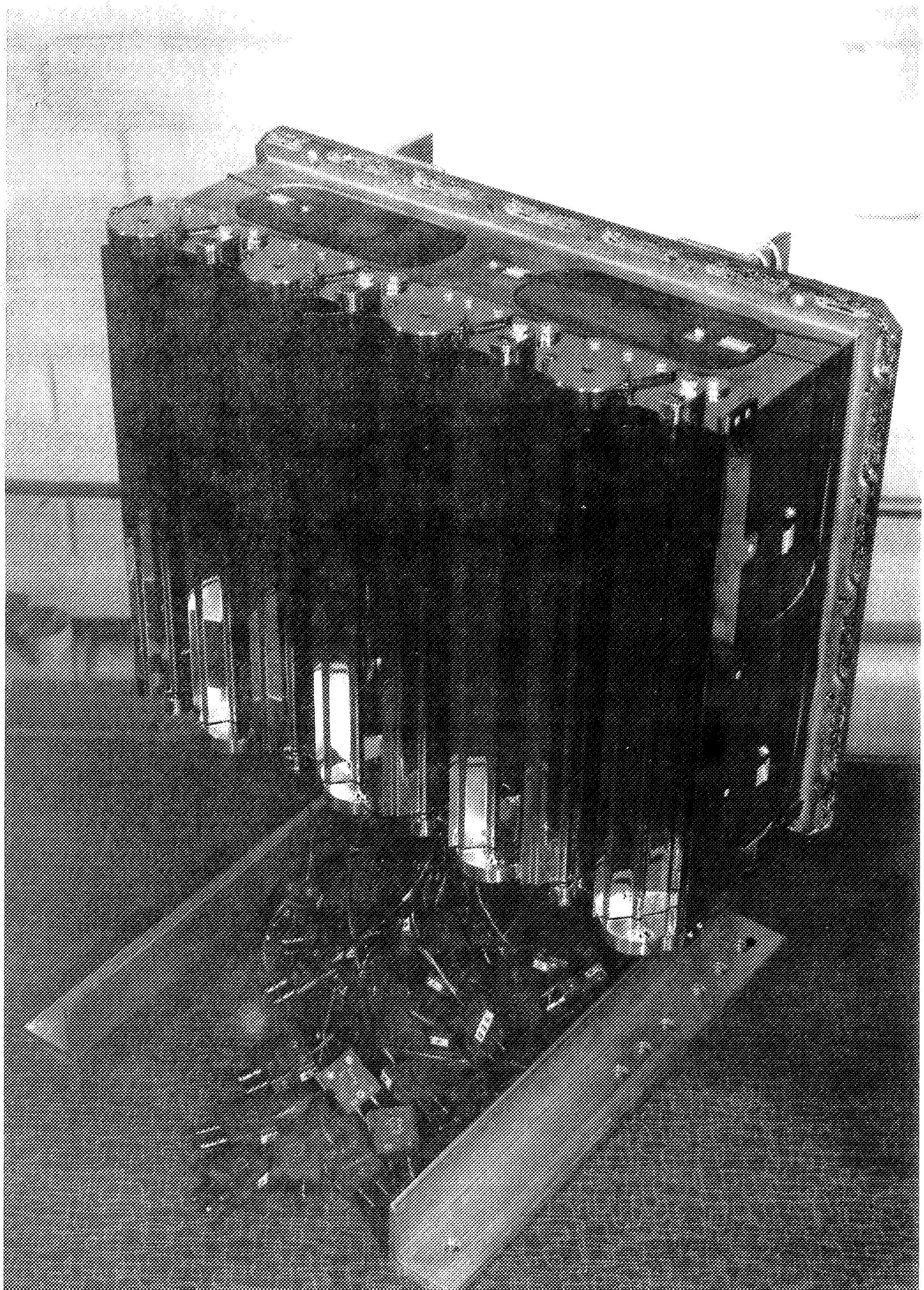

Fig. 1

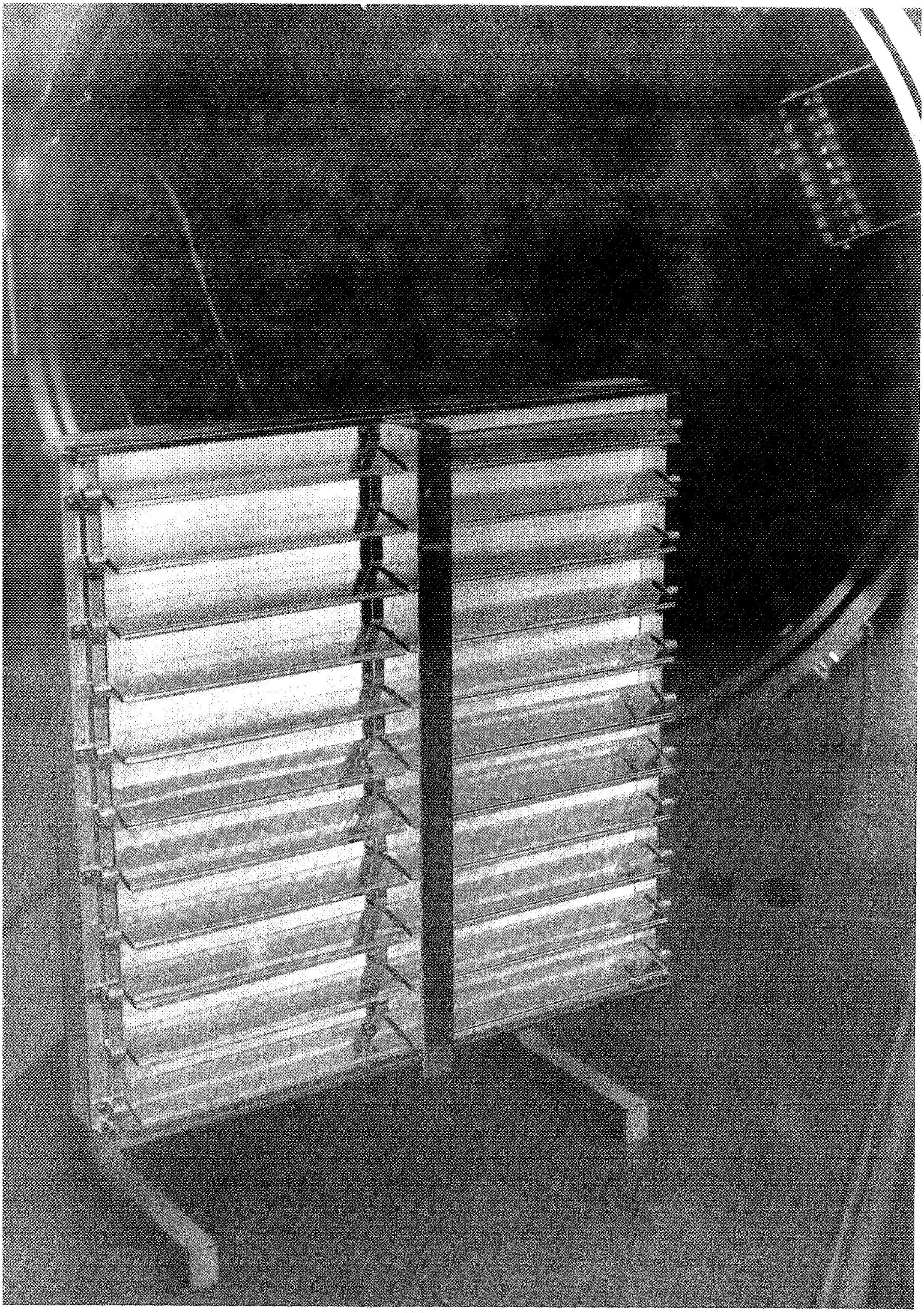

Fig. 2